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Digestion Experiments With Texas Hays and Fodders

BY

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DIGESTION EXPERIMENTS WITH TEXAS HAYS AND FODDERS.

BY

G. S. FRAPS, Chemist.

The work here described is preliminary to the more thorough and detailed investigations under the Adams Fund, which will be reported later. The results of the digestion tests of the ordinary fodder groups is reported in this separate bulletin, as this work has a more general and popular interest than the detailed work.

DEFINITION OF TERMS.

The ordinary analysis of a feeding stuff gives its content of water, ash, protein, ether extract, crude fiber, and nitrogen-free extract, expressed in percentages.

Protein, being the constituent of food which forms flesh, muscle, hair, ligaments, and other portions of the animal body, is of great importance. It replaces the wear and tear of the animal tissue and furnishes material for additional flesh. Besides furnishing material for tissue, protein may be burned in the body to produce heat, or it may serve as a source of fat in case of a deficiency in carbohydrates and fat accompanied by excess of protein. It is, however, a costly source of heat and fat. Protein is the most expensive portion of a food, and feeds rich in protein usually sell for a higher price than feeds low in protein, though the difference is not as great in Texas as in the Northern States. With a given feed, the more protein it contains, the better its quality, compared with other feeds of the same kind.

Ether Extract is composed mainly of fats and oils in the case of concentrated feeding stuffs, but with fodders and hays it is often composed to a considerable extent of waxes, coloring matter, and other substances. Fat is used in the animal body as a source of body fat and to furnish heat and energy. The animal requires heat to keep its body warm and energy to run the animal mechanism or to do outside work. The beating of the heart, chewing, movements of the intestines, and the involuntary muscular movements require energy which is furnished by the oxidation of fats, carbohydrates or protein. One pound of fat is equal to 2.25 pounds of carbohydrates. Fat ranks next to protein in its value in a feeding stuff. The more protein and fat a given feed contains, the better its quality compared with other feeds of the same kind.

Crude fiber is the portion of the plant which resists the intense action of acids and alkalies. It consists mostly of the cell walls and woody fiber of the plant, and is the most indigestible part of the feed stuff. By means of fermentation in the intestines, crude fiber is digested to some extent in animals which chew the cud. The opera-

tion, however, consumes so much energy that a large portion of the value of the crude fiber is taken up by the process of digestion. Hays and fodders and other roughage generally contain much crude fiber, but concentrated feeding stuffs comparatively small quantities of it. Crude fiber is the woody and less digestible portion of a feeding stuff. The more crude fiber a feed contains, the poorer its quality compared with other feeds of the same kind. Crude fiber contains some cellulose, which is a carbohydrate.

Nitrogen-free extract is composed of starch, sugar, dextrin, and other substances of similar nature. These substances are mostly carbohydrates; that is, they contain carbon and hydrogen in proportions to form water. Crude fiber is also composed largely of carbohydrates. The nitrogen-free extract of most concentrated feeding stuffs, such as corn chops, wheat bran, cottonseed meal, Kaffir corn, is composed largely of sugars and starches which are readily digested and have considerable value to the animal.

The nitrogen-free extract of wheat skins, corn bran, cobs, rice hulls, hays and straws, and similar feeds, is composed mostly of other substances than sugar and starch, and has a lower value to animals. The nitrogen-free extract of these two kinds of feeds, therefore, can not be compared directly.

In general, we may say that the more protein, fat and nitrogen-free extract, and the less crude fiber and ash a given feed contains, compared with other feeds of the same kind, the better the quality of the feeding stuff, and the reverse is also true.

The same statement also holds in comparing feeding stuffs of different kinds, but not altogether; since, in comparing feeds of different kinds we must also consider their digestibility and the productive value of the digested material.

Ash is the residue left when the plant is burned. It represents mostly the mineral portion of the plant and the portion which comes from the soil, although a part of the ingredients withdrawn from the soil are volatilized during combustion. Nitrogen particularly is driven out completely. Ash is valuable to the animal, inasmuch as it furnishes the material for bones, and some constituents of it, particularly, phosphoric acid and sulphur, are essential constituents of the animal cell. Ash is necessarily present in feeding stuffs. An excessive amount indicates contamination with dirt, sand, or other mineral matter. Too little ash in the ration fed may give rise to disorders, especially in young animals.

Water (moisture) is always contained in feeding stuffs, but since it is furnished for the most part in liquid form, it can not be considered as having any special nutritive value. The more water a feeding stuff contains, the less of the other nutrients it contains, and the more liable it is to be injured by heating, mold, etc. The water content of feeds varies, being larger in fresh grain.

COMPOSITION AND DESCRIPTION OF FEEDS.

The average composition of the feeds, and composition of the feeds used in the experiments described in this bulletin, are given in Table

1. The average is drawn from all available analyses, as detailed in Table 9.

Alfalfa. Alfalfa hay used in Digestion Experiment No. 3, appeared to be first growth alfalfa, was reasonably free from weeds and foreign matter, and had a considerable amount of alfalfa leaves. It was somewhat above the average in protein.

Bermuda hay. The average protein given for Bermuda is probably higher than that actually on the market. It is not believed by us that the average composition in the table represents the average composition of the hay on the market. Bermuda hay used in digestion experiment No. 12, was free from dirt and contained only a small amount of weeds and foreign grasses. It was eaten readily and completely by the sheep. It was much below the average composition in protein and fat, and higher in crude fiber.

TABLE 1—AVERAGE COMPOSITION OF FEEDING STUFFS AND COMPOSITION OF THOSE USED IN THE EXPERIMENTS.

	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Water.	Ash.
Alfalfa hay, average	14.42	1.97	29.78	35.81	9.61	8.41
Alfalfa hay used in Experiment No. 3	16.17	1.41	28.34	34.96	10.99	8.14
Bermuda hay, average	10.88	2.14	22.96	46.37	10.05	7.60
Bermuda hay used in Experiment No. 12	6.43	1.60	27.62	46.70	9.74	7.88
Burr clover used in Experiment No. 6	23.43	2.12	20.81	31.83	9.73	12.10
Buffalo grass, average	7.85	1.83	26.13	45.29	7.57	11.34
Buffalo grass used in Experiment No. 9	7.05	1.20	27.64	45.43	7.30	11.55
Corn shucks used in Experiment No. 17	3.20	0.68	30.32	54.60	7.75	3.47
Cowpea hay, average	14.56	2.72	23.31	41.53	10.04	7.82
Cowpea hay used in Experiment No. 1	14.66	3.02	26.18	34.37	12.73	9.05
Guam grass used in Experiment No. 16	8.43	1.73	26.00	49.40	7.66	6.79
Johnson grass hay, average	7.22	1.90	80.00	44.06	9.70	7.12
Johnson grass hay used in Experiment No. 4	7.44	1.68	27.40	42.44	8.69	12.36
Johnson grass hay used in Experiment No. 10	6.92	1.40	30.76	44.73	8.06	8.13
Kafir fodder, average	13.10	4.15	22.37	40.18	8.37	11.83
Kafir fodder used in Experiment No. 15	9.90	2.13	23.80	44.33	8.57	11.25
Millet, average	7.75	2.25	28.72	43.19	10.21	7.88
Millet used in Experiment No. 11	4.22	1.62	27.91	48.37	9.42	8.97
Oat hay, average	7.72	2.89	27.80	42.16	13.44	5.99
Oat hay, used in Experiment No. 5	8.04	2.41	27.87	44.22	8.36	9.02
Peanut hay, average	11.99	7.98	24.61	39.38	8.82	7.22
Peanut hay used in Experiment No. 13	13.56	8.56	22.82	39.02	8.60	7.44
Para grass used in Experiment No. 14	3.34	0.91	33.80	46.71	8.36	7.10
Rice straw, average	4.11	1.54	31.56	41.37	6.57	14.85
Rice straw, Japan, Experiment No. 7	3.92	1.24	33.26	37.82	6.68	17.10
Rice straw, Honduras, Experiment No. 18	3.98	1.15	30.65	40.62	7.46	16.16
Sorghum hay, average	9.10	3.42	24.40	45.73	8.55	8.80
Sorghum hay used in Experiment No. 2	5.58	1.66	28.07	47.24	10.56	6.91
Vetch hay, average	17.72	2.30	23.33	35.94	13.18	7.53
Vetch hay used in Experiment No. 8	15.00	1.58	27.28	37.53	6.76	11.87

Burr clover hay used in digestion experiment No. 6 was cut on the College campus and dried in a large air drying apparatus in the laboratory, before chopping. The clover was in bloom with most of the seed formed. It was free from dirt and was readily and completely eaten by the sheep. Samples of burr clover were also collected by Mr. J. B. Rather, assistant chemist, at various stages of growth. Results of these analyses are in Table 2. The percentage of protein, fat, water and ash decrease with the age of the clover. The crude fiber increases.

TABLE 2—BURR CLOVER COLLECTED IN DIFFERENT STAGES OF GROWTH.

Laboratory No.		Date collected.	Protein.	Fat	Crude fiber.	Nitrogen free-extract.	Water.	Ash.	Water in preparation for analysis.
3330	Just in bloom	Mar. 23	27.10	4.18	14.12	40.49	3.02	11.09	83.8
3511	Full bloom, part of seeds formed.	April 2	24.00	3.23	16.95	38.19	7.43	10.20	83.5
3518	Most of seeds formed	April 14	20.75	2.97	21.85	41.13	2.72	10.58	84.5
3586	Still in bloom	April 21	21.06	3.92	21.25	38.47	5.96	9.40	82.6
3601	Part of leaves dying, still blooms.	April 28	16.43	2.48	25.59	40.70	5.95	8.85	74.6
3608	All seeds formed, some leaves dry and dropping off.	May 7	15.70	2.58	30.58	36.76	6.90	7.48	58.8
3628	Most of leaves and burrs have dropped off	May 20	11.01	1.84	38.25	33.46	7.05	8.39	56.7

Buffalo Grass hay used in digestion experiment No. 9. This hay is about the average in quality. Where buffalo grass is grown the farmers usually allow it to come up in the corn fields after the crop is laid by, and cut it in the fall. This hay was sent us by A. T. Potts of the Beeville Substation, Beeville, Texas. It was eaten readily after the sheep became accustomed to it.

Baled Corn shucks used in digestion experiment No. 17. The shucks comprised the husk proper, and also the "butt," or the portion connected with the stalk. There was no foreign material present with the exception of a few cobs and "nubbins." One bale was a trifle musty. The sheep ate the feed quite well. It was rather surprising to find such a small number of analyses of this product in the literature.

Cowpea hay used in digestion experiment No. 1, consisted of the vines and leaves, no peas being found. In weighing out the rations, portions were taken from different parts of the piles to make them as uniform as possible. The hay was eaten readily by the animals at all times. It was obtained from the farm department of this College. The hay was about average in protein, but somewhat higher in crude fiber and much lower in nitrogen-free extract.

Guam Grass, used in digestion experiment No. 16, was furnished by the Long Lake Plantation, Long Lake, Texas. The hay was good quality and free from dirt and weeds. The bulk of this grass consists of Tripsascum Floridanum (Porter) and grows in moist places in Florida and Texas. The sheep ate the feed with relish.

Johnson Grass hay, used in digestion experiment No. 4. Two bales of this hay were obtained from Bryan, Texas. One bale appeared to be reasonably good quality, a small amount of weeds and dirt being present. The other bale contained a large amount of weeds, trash and dirt and was evidently made from scraps of hay left around the press after the baling had been finished. A large amount of the dirt was removed in the chopping and mixing of the sample. The bales contained no large stalks of grass and it was evidently a young cut hay. The sheep did not eat this feed readily.

Johnson Grass hay, used in digestion experiment No. 10. The grass was coarse stemmed, but cleaner and apparently better quality than that used in digestion experiment No. 4. The sheep ate the feed readily and completely. The first lot of Johnson grass hay had a

better chemical composition than the second, though both were near the average.

Baled Kaffir Fodder, used in digestion experiment No. 15, contained no head, was free from grasses, but was damp in the middle of the bales and contained considerable dirt. Two sheep ate the feed completely. Sheep No. 6 left a considerable amount of stalk, but the digestion of this animal was deranged more or less throughout the whole period. The average composition of Kaffir fodder shown in the table is, we believe, superior to that sold on the market or used for feed. The composition of the sample subjected to analysis is probably more nearly that of the commercial product than the average is.

Baled Millet, used in digestion experiment No. 11, was good quality, with heads and was nearly free from weeds and other foreign substances. The sheep ate this feed readily. It is much below the average composition in protein.

Oat Hay, used in digestion experiment No. 5, came from the College farm and was very near the average composition.

Peanut Hay, used in digestion experiment No. 13. Nearly all the vines had peanuts on them. A small amount of dirt and weeds was present. The sheep ate the hay eagerly at all times. The composition of the hay was somewhat better than the average.

Para Grass Hay, used in digestion experiment No. 14, was free from weeds but contained a little dirt and was musty. The sheep did not eat the feed well and showed a tendency to select the leaves in preference to the stalks.

Japan Rice Straw, used in digestion experiment No. 7, from estate of A. H. Pierce, Pierce, Texas, was free from dirt and weeds, but contained a small amount of rice heads. A preliminary ration of rice straw and cottonseed meal was fed to accustom the sheep to the feed. They ate it, however, with much dislike and a large amount was left at the end of the experiment.

Baled Honduras Rice Straw, used in digestion experiment No. 18, was excellent quality and free from weeds and grasses. Sheep No. 1 ate his ration completely but more readily during the preliminary period. Sheep Nos. 4 and 5 did not eat as well as No. 1 and left considerable residues.

Sorghum Hay, used in digestion experiment No. 2, was not fully matured; it was partly headed, but the heads were not full. It was dry and nearly free from grass and weeds. The hay was eaten readily at all times. It was considerably below the average in protein and fat and higher in crude fiber.

Vetch Hay, used in digestion experiment No. 8, was a bright and clean sample and was eaten with much relish. No residue was left after the preliminary and collection periods. It is somewhat below the average in protein and fat and higher in crude fiber.

DIGESTIBILITY.

By the digestibility of a feed, we mean that proportion of the different nutrients which disappears in the passage of the food through the animal. Since we know that a portion which disappears is

changed by fermentation into the gases, carbon dioxide and marsh gas, we know that all the so-called digested nutrients do not enter into the system of the animal or become valuable to it. Further, we now know that the digested nutrients of one feed do not necessarily have the same value to the animal, pound for pound, as the digested nutrients of another feed. For example, a pound of digested nitrogen-free extract from corn chops has a greater value to the animal than a pound of digested nitrogen-free extract from alfalfa hay. This has been definitely shown by the work of Kellner. We will discuss this matter a little later in connection with the productive value of feeds.

The digestibility of a feed, and its content of digestible nutrients is, nevertheless, of great significance in judging the nutritive value of a feed. The feeding value can be calculated, more or less accurately, from the digestion value.

By coefficient of digestibility we mean the percentage or the proportion which is digested. For example, suppose the coefficient of digestibility of protein in green corn is given at 59.7. This means that 59.7 per cent of all the protein in the corn disappears in the passage of the feeding stuff through the animal.

COEFFICIENT OF DIGESTIBILITY OF THE FEEDS.

The coefficient of digestibility of the feeds tested, and the average coefficients of digestibility of these feeds, are given in Table 3. The averages are taken from the experiments detailed in Table 10. The Texas experiments are included in the averages given. The protein of burr clover, alfalfa hay, cowpea hay, peanut hay, and vetch hays, has the highest coefficient of digestibility. Corn shucks, para grass and rice straw rank lowest. Ether extract of alfalfa, burr clover and rice straw were little digested in our experiments.

TABLE 3—AVERAGE COEFFICIENT OF DIGESTIBILITY OF FEEDING STUFFS AND OF THOSE FOUND IN THE EXPERIMENTS.

Description.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Ash.
Alfalfa hay, average	75.3	40.5	46.4	68.4	50.1
Alfalfa hay, Experiment No. 3	73.8	4.9	45.4	65.0	58.0
Bermuda hay, average	57.5	43.3	54.9	51.5	34.8
Bermuda hay, Experiment No. 12	48.8	46.9	50.8	50.2	28.0
Burr clover, Experiment No. 6	80.7	5.4	64.2	75.9	62.6
Buffalo grass, average	53.8	49.0	61.5	59.9	15.2
Buffalo grass, Experiment No. 9	53.2	35.5	58.4	58.0	24.3
Corn shucks, Experiment No. 17	12.5	38.6	69.3	60.6	21.5
Cowpea hay, average	68.5	40.2	46.7	67.9	30.3
Cowpea hay, Experiment No. 1	72.3	28.6	51.5	65.3	11.0
Guam grass, Experiment No. 16	50.7	57.2	57.1	53.8	28.4
Johnson grass hay, average	43.9	44.6	66.2	56.8	27.1
Johnson grass hay, Experiment No. 4	41.0	52.2	65.9	52.3	13.9
Johnson grass hay, Experiment No. 10	51.8	49.3	67.6	61.0	33.4
Kafir fodder, Experiment No. 15	63.0	53.1	67.1	69.4	43.6
Millet, average	52.2	49.6	64.4	56.7	54.3
Millet, Experiment No. 11	30.3	56.4	65.1	59.3	31.3
Oat hay, average	54.4	62.9	52.7	56.7	37.2
Oat hay, Experiment No. 5	58.5	68.9	67.8	66.8	28.4
Peanut hay, average	71.0	78.0	52.2	71.9	20.9
Peanut hay, Experiment No. 13	78.6	90.0	52.4	74.3	21.3
Para grass, Experiment No. 14	9.9	45.0	52.8	46.9	23.2
Rice straw, Experiment No. 7 (Japan)	16.8	6.4	60.3	45.0	12.1
Rice straw, Experiment No. 18 (Honduras)	26.6	36.4	58.0	47.3	15.0
Sorghum hay, average	42.7	65.0	62.3	63.3	33.9
Sorghum hay, Experiment No. 2	31.6	53.5	66.8	65.0	33.8
Vetch hay, average	67.6	55.2	56.4	72.6	44.1
Vetch hay, Experiment No. 8	74.2	42.4	54.5	74.5	28.3

DIGESTIBLE NUTRIENTS IN THE FEEDS.

The average quantity of digestible nutrients in the various feeds, and the quantity found present in the feeds used in the experiment are given in Table 4. This table gives the best means of comparing the feeds yet given in this bulletin, but the method based on the actual productive values of the feeds is still better.

Burr clover, vetch hay, alfalfa and cowpea hay rank highest in digestible protein. Peanut hay is highest in digestible fat. Corn shucks and rice straw are lowest in digestible protein.

TABLE 4—DIGESTIBLE CONSTITUENTS OF FEEDS STUDIED, AND AVERAGE DIGESTIBLE CONSTITUENTS.

Description.	Protein.	Ether extract.	Crude fiber.	Nitrogen free extract.	Ash.	Nutritive ratio.
Alfalfa hay, average	10.9	0.8	13.8	24.5	4.2	3.7
Alfalfa hay, Experiment No. 3	11.9	0.1	12.9	22.7	4.7	3.0
Bermuda hay, average	6.3	0.9	12.6	23.9	2.6	6.1
Bermuda hay, Experiment No. 12	3.1	0.8	14.5	23.4	2.2	12.6
Burr clover, Experiment No. 6	18.9	0.0	13.4	24.2	7.6	2.0
Buffalo grass, average	4.2	0.9	16.1	27.5	1.7	10.8
Buffalo grass, Experiment No. 9	3.8	0.4	16.1	26.3	2.8	11.4
Corn shucks, Experiment No. 17	0.4	0.3	21.0	33.1	0.7	137.0
Cowpea hay, average	10.0	1.1	10.9	28.2	23.7	4.2
Cowpea hay, Experiment No. 1	10.6	0.9	13.5	22.4	1.0	3.6
Guam grass, Experiment No. 16	4.3	1.0	14.8	26.6	1.9	10.1
Johnson grass hay, average	3.2	0.8	19.9	25.0	1.9	14.6
Johnson grass hay, Experiment No. 4	3.1	0.9	18.1	22.2	1.7	13.6
Johnson grass hay, Experiment No. 10	3.6	0.7	20.8	27.3	2.7	13.8
Kafir fodder, average*	8.3	2.2	15.0	27.9	5.2	5.7
Kafir fodder, Experiment No. 15	6.2	1.1	16.0	30.8	4.9	7.9
Millet, average	4.0	1.1	18.5	24.5	4.3	11.4
Millet, Experiment No. 11	1.3	0.9	18.2	28.7	2.8	57.6
Oat hay, average	4.2	1.8	14.7	23.9	2.2	10.1
Oat hay, Experiment No. 5	4.7	1.7	18.9	29.5	2.6	11.1
Peanut hay, average	8.5	6.2	12.8	28.3	1.5	6.4
Peanut hay, Experiment No. 13	10.7	7.7	12.0	29.0	1.6	5.4
Para grass hay, Experiment No. 14	0.3	0.4	17.8	21.9	1.6	135.3
Rice straw, average†	0.9	0.3	18.7	19.1	2.0	42.8
Rice straw, Experiment No. 7 (Japan)	0.7	0.1	20.1	17.0	2.1	53.3
Rice straw, Experiment No. 18 (Honduras)	1.1	0.5	17.8	19.2	2.4	34.6
Sorghum hay, average	3.9	2.2	15.2	28.9	3.0	12.5
Sorghum hay, Experiment No. 2	1.8	0.9	18.8	30.7	2.3	28.6
Vetch hay, average	12.0	1.3	13.2	26.1	3.3	3.5
Vetch hay, Experiment No. 8	11.1	0.7	14.9	28.0	3.4	4.0

*Coefficients of digestibility obtained in our experiments used in making calculations.

†Average coefficients of digestibility of Japan and Honduras rice straw obtained in our experiments used in making calculations.

PRODUCTIVE VALUES OF FEEDS.

It takes a certain amount of work for an animal to chew and digest its food. The amount of work varies with different feeds. The value of the feed to the animal is decreased by the amount of energy expended in its digestion. Coarse and bulky foods require relatively more digestive energy than do concentrated feeds. Grinding or chopping the feed reduces the labor of chewing and decreases the energy expended in digestion.

A portion of the value of the feed is lost in fermentation. Marsh gas is evolved, which carries off energy. The value of the feed to the animal is decreased by the amount of the loss.

A portion of the value of the feed is eliminated in the undigested residues, and as organic substances in the liquid excrement.

When these losses are deducted, what remains of the food may be utilized for the purposes of the animal. It is used, first, to keep the animal warm and to perform functions necessary to the life of the animal.

The excess, if any, is used in the manufacture of fat, flesh or milk, in work or in movements of the animal body. It is thus seen that only a portion of the feed is available for what may be termed *productive* purposes.

The productive value of feeds has been measured by Kellner. He determined exactly the quantity of fat and flesh laid on by an animal with a given ration, and then to this ration he added the feed to be tested, and again determined the gain in fat and flesh. The increased gain was due to the addition, and as the amount of the increase was known, the effect of the addition was known exactly. The flesh was calculated to fat. The productive value of the feed can thus be expressed in terms of the number of pounds of fat which it will produce when added to a ration already sufficient for the needs of the animal. By using Kellner's results, the relative productive value of feeds can be calculated from their content of digestible nutrients.

In judging the value of a feed we must consider not only its productive value "fat value" but also its content of protein, or flesh forming material.

Table 5 contains the productive values of the feeds as ascertained in the experiment, and also the average productive values as based on Table 4. The digestible protein and the relative value is also given. The "relative value" must be considered as only provisional, because it is secured by combining productive value and protein, assuming the protein to have a value for flesh equal to its fat value, and protein varies in value according to conditions. Under certain conditions, the value of a feed would be measured by its productive value only. The productive value is given as the number of pounds of fat which may be produced by 100 pounds of the feed when added to a ration already sufficient for the needs of the animal for maintenance purposes.

The relative values of average Bermuda hay, burr clover, and Kaffir fodder, are probably in excess of the average value of these hays as sold on the market.

The value given for para grass is probably below its average value.

TABLE 5—DIGESTIBLE CRUDE PROTEIN AND PRODUCTIVE VALUES OF FEEDS STUDIED.

	Digestible crude protein.	Productive value expressed as fat.	Relative value.
Alfalfa hay, average	10.9	8.5	11.2
Alfalfa hay, Experiment No. 3	11.9	7.9	10.9
Bermuda hay, average	6.3	8.0	9.6
Bermuda hay, Experiment No. 12	3.1	6.6	7.4
Burr clover, Experiment No. 6	18.9	11.2	15.9
Buffalo grass, average	4.2	8.6	9.6
Buffalo grass, Experiment No. 9	3.8	7.9	8.7
Corn shucks, Experiment No. 17	0.4	9.6	9.7
Cowpea hay, average	10.0	9.5	12.0
Cowpea hay, Experiment No. 1	10.6	8.4	11.1
Guam grass, Experiment No. 16	4.3	8.3	9.4
Johnson grass, average	3.2	8.2	9.0
Johnson grass, Experiment No. 4	3.1	7.5	8.3
Johnson grass, Experiment No. 10	3.6	9.0	9.9
Kafir fodder, average	8.3	10.8	12.9
Kafir fodder, Experiment No. 15	6.2	10.5	12.1
Millet, average	4.0	8.3	9.3
Millet, Experiment No. 11	1.3	8.6	8.9
Oat hay, average	4.2	7.7	8.8
Oat hay, Experiment No. 5	4.7	10.2	11.4
Peanut hay, average	8.5	12.1	12.2
Peanut hay, Experiment No. 13	10.7	13.6	16.3
Para grass, Experiment No. 14	0.3	5.5	5.6
Rice straw, average	0.9	5.4	5.6
Rice straw, Experiment No. 7 (Japan)	0.7	4.8	5.0
Rice straw, Experiment No. 18 (Honduras)	1.1	5.5	5.8
Sorgum hay, average	3.9	9.7	10.7
Sorgum hay, Experiment No. 2	1.8	9.4	9.9
Vetch hay, average	12.0	10.2	13.2
Vetch hay, Experiment No. 8	11.1	10.1	12.9
Cottonseed meal	39.0	19.1	28.8
Wheat bran	12.5	12.0	15.1
Corn chops	6.5	20.6	20.6

METHOD OF CONDUCTING THE DIGESTION EXPERIMENTS.

Preparation of Sample. The feed to be tested is passed through the feed chopper after being freed from sticks and weeds, if any be present. The chopper is adjusted to cut the feed in about half inch lengths, and the feed is run through two or more times, depending on the nature of the sample and the degree of fineness obtained. The chopped feed is thoroughly mixed on a clean floor.

The quality of the feed, the presence of dirt and approximate amount and nature of weeds and foreign grasses removed are reported.

Preliminary Feeding Period. This is to accustom the animal to the feed and to determine how much they will eat per day. Ordinarily, the feed may be substituted for that which the animals are already eating, increasing the amount substituted each meal until the full ration is fed.

Weighing Out Rations. The sheep having been accustomed to the feed, the weight of the ration is determined (usually 225 or 250 grams) and weighed out for the whole experiment beforehand. A bag is counterpoised on the torsion balance and the feed weighed into it. Each bag is counterpoised separately. After each bag has had the ration put in, another is inverted over it and pulled down until the full bag is entirely within the other. The number of rations to be weighed out depends on the number of sheep to be used, as the feeding lasts 16 days (2 sheep, 64 rations; 3 sheep, 96 rations).

Four extra rations are weighed out and substituted for rations in the first, one-half; two-thirds; and last part of the stock. These latter are to be brought to laboratory and prepared for analysis.

Feeding Period. The sheep are fed at 8:15 a. m., and 3:45 p. m., daily. Water is kept in stalls in buckets and fresh water put in every morning.

Before starting the feeding, all residues from previous feeds are removed from the feed box, stall and vicinity. The feeding period is continued eight days. On the day before the collecting period begins the harness is put on and adjusted so there may be no delay in putting on the bags. On the morning the feeding period ends, the uneaten feed is collected and weighed. Any feed mixed with urine or water is collected separately, dried, weighed and discarded. The other residue is returned to the feed box.

Collecting Period. The bags are put on at 8:15 a. m., and removed at the same hour at the end of the period, which lasts 8 days. The feces are collected at 8:15 a. m., and 3:45 p. m., the sheep being fed immediately after. The scattered feed is collected as before. The feces are placed in fruit jars, brought to laboratory and weighed. They are then placed on marked pans and put in air-ovens to dry. When the period is over, the uneaten residues are collected and weighed as before (feeding period).

After Treatment. The sheep are not to be fed too much grain for a few days after the experiment, one-half pint chops per ration will do. They may be fed all the hay (prairie) they will eat. The feces are allowed to dry for about a week after the experiment ends and then weighed and placed in tin buckets with tightly fitting lids.

Preparation of Samples. The individual weights of the feces should total to 2 or 3 grams of the weight of the whole amount weighed together.

The dried feces should be pounded in a mortar and ground as quickly as possible in mill. The weights before and after preparation are to be noted. Each sample of feces is then mixed thoroughly on a large piece of paper and placed in dry fruit jars.

The feed samples are divided into two samples of two sacks each, and registered under two numbers. They are to be chopped and run through mill until they are the required fineness. Weights before and after preparation are to be noted. The loss in preparation in feed and feces should not be more than 15 grams per sample.

The presence of any large quantity of uneaten residues introduces an uncertainty in the work, since the amount eaten during the preliminary period is not always the same as during the digestion period. As a rule, the animal eats a little more during the digestion period, when a residue is left. We have divided the total residue for the entire 16 days by two, when any large quantity was left uneaten during both periods.

Analytical Methods. Analytical methods used are those of the Association of Official Agricultural Chemists. All results reported are averages of two or more determinations.

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TABLE 6—COMPOSITION OF FEEDING STUFFS AND RESIDUES FROM DIGESTION EXPERIMENTS.

Laboratory No.	Description.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Water.	Ash.
3220	Cowpea hay, D. E. I, Sample 1	14.80	3.03	25.97	34.42	12.68	9.10
3221	Cowpea hay, D. E. I, Sample 2	14.51	3.00	26.39	34.32	12.78	9.00
	Average	14.66	3.02	26.18	34.37	12.73	9.05
3224	Sorghum hay, D. E. II, Sample 1	5.67	1.64	28.18	46.79	10.87	6.85
3225	Sorghum hay, D. E. II, Sample 2	5.49	1.67	27.95	47.68	10.25	6.96
	Average	5.58	1.66	28.07	47.24	10.56	6.91
3277	Alfalfa hay, D. E. III, Sample 1	16.34	1.49	28.39	34.78	10.68	8.32
3278	Alfalfa hay, D. E. III, Sample 2	15.99	1.33	28.29	35.13	11.30	7.96
	Average	16.17	1.41	28.34	34.96	10.99	8.14
3283	Residue Sheep 4, D. E. III (Alfalfa)	10.66	0.72	42.38	33.47	4.64	8.13
3587	Johnson grass hay, D. E. IV, Sample 1.	7.54	1.60	27.11	41.87	8.78	13.10
3588	Johnson grass hay, D. E. IV, Sample 2.	7.34	1.75	27.69	43.01	8.60	11.61
	Average	7.44	1.68	27.40	42.44	8.69	12.36
3592	Residue Sheep 1, D. E. IV (Johnson grass).	5.31	0.88	13.07	19.56	6.24	54.94
3593	Residue Sheep 3, D. E. IV (Johnson grass).	3.97	0.57	34.66	36.50	13.12	11.18
3594	Residue Sheep 4, D. E. IV (Johnson grass).	4.53	0.58	26.82	28.74	9.08	30.25
3595	Oat hay, D. E. V, Sample 1	7.89	2.40	27.90	44.39	8.48	8.94
3596	Oat hay, D. E. V, Sample 2	8.18	2.42	27.83	44.04	8.23	9.10
	Average	8.04	2.41	27.87	44.22	8.36	9.02
3599	Residue Sheep 1, D. E. V (Oat hay)	8.20	2.15	24.48	38.66	7.61	18.90
3600	Residue Sheep 4, D. E. V (Oat hay)	8.01	2.00	26.99	39.76	7.81	15.43
3609	Burr clover D. E. VI, Sample 1	23.20	2.16	21.21	31.91	9.90	11.62
3610	Burr clover, D. E. VI, Sample 2	23.66	2.07	20.40	31.74	9.56	12.57
	Average	23.43	2.12	20.81	31.83	9.73	12.10
3625	Japan rice straw, D. E. VII, Sample 1	4.03	1.20	33.46	37.52	6.64	17.15
3626	Japan rice straw, D. E. VII, Sample 2	3.80	1.27	33.05	38.11	6.72	17.05
	Average	3.92	1.24	33.26	37.82	6.68	17.10
3880	Residue Sheep 2, D. E. VII (Rice straw).	5.44	1.13	32.97	36.12	6.55	17.79
3881	Residue Sheep 3, D. E. VII (Rice straw).	3.68	0.80	35.76	36.25	6.08	17.43
3882	Residue Sheep 4, D. E. VII (Rice straw).	3.91	1.11	33.42	38.54	6.02	17.00
3649	Vetch hay, D. E. VIII, Sample 1	14.96	1.62	27.57	37.30	6.69	11.86
3650	Vetch hay, D. E. VIII, Sample 2	15.03	1.53	26.99	37.75	6.83	11.87
	Average	15.00	1.58	27.28	37.53	6.76	11.87
3883	Buffalo grass hay, D. E. IX, Sample 1.	7.05	1.24	28.22	44.87	7.36	11.26
3884	Buffalo grass hay, D. E. IX, Sample 2.	7.05	1.16	27.05	45.98	6.93	11.83
	Average	7.05	1.20	27.64	45.43	7.30	11.55
4238	Johnson grass hay, D. E. X, Sample 1.	7.07	1.39	31.08	44.73	7.83	7.90
4239	Johnson grass hay, D. E. X, Sample 2.	6.77	1.41	30.44	44.73	8.29	8.36
	Average	6.92	1.40	30.76	44.73	8.06	8.13
4247	Baled millet, D. E. XI, Sample 1	4.48	1.71	27.89	47.89	9.03	9.00
4248	Baled millet, D. E. XI, Sample 2	3.96	1.53	27.92	48.85	9.81	8.93
	Average	4.22	1.62	27.91	48.37	9.42	8.97
4252	Bermuda hay, D. E. XII, Sample 1	6.37	1.58	27.37	46.26	10.61	7.81
4253	Bermuda hay, D. E. XII, Sample 2	6.49	1.62	27.94	47.14	8.86	7.95
	Average	6.43	1.60	27.62	46.70	9.74	7.88
4259	Peanut hay, D. E. XIII, Sample 1	13.48	7.91	23.14	39.89	8.74	6.84
4260	Peanut hay, D. E. XIII, Sample 2	13.64	9.21	22.50	38.15	8.46	8.04
	Average	13.56	8.56	22.82	39.02	8.60	7.44
4277	Para grass, D. E. XIV, Sample 1	3.34	0.93	33.84	46.17	8.70	7.02
4278	Para Grass, D. E. XIV, Sample 2	3.34	0.89	33.76	46.83	8.01	7.17
	Average	3.34	0.91	33.80	46.74	8.36	7.10
4282	Residue Para grass, D. E. XIV, Sheep 1.	3.83	1.01	31.77	46.16	8.97	8.26

TABLE 6—COMPOSITION OF FEEDING STUFFS AND RESIDUES FROM DIGESTION EXPERIMENTS—continued.

Laboratory No.	Description.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Water.	Ash.
4283	Residue Para grass, D. E. XIV, Sheep 3.	3.86	0.93	29.86	46.77	8.23	10.35
4284	Residue Para grass, D. E. XIV, Sheep 4.	4.87	1.16	30.66	44.89	8.55	9.87
4546	Kaffir fodder, D. E. XV, Sample 1	9.83	2.16	23.68	44.44	8.64	11.25
4547	Kaffir fodder, D. E. XV, Sample 2	10.14	2.10	23.81	44.22	8.49	11.24
	Average	9.99	2.13	23.80	44.33	8.57	11.25
4551	Residue Kaffir fodder, D. E. XV, Sheep 6.	8.64	1.80	29.82	39.59	8.70	11.45
4552	Guam grass, D. E. XVI, Sample 1	8.46	1.73	25.80	49.63	7.45	6.93
4553	Guam grass, D. E. XVI, Sample 2	8.40	1.72	26.20	49.16	7.87	6.65
	Average	8.43	1.73	26.00	49.40	7.66	6.79
4557	Corn shucks, D. E. XVII, Sample 1	3.26	0.62	30.33	54.51	7.85	3.43
4558	Corn shucks, D. E., XVII, Sample 2	3.13	0.74	30.31	54.68	7.64	3.50
	Average	3.20	0.68	30.32	54.60	7.75	3.47
4562	Residue corn shucks, D. E. 17, Sheep 4	8.92	0.99	23.62	41.05	6.91	18.51
4663	Honduras rice straw, D. E. XVIII, Sample 1.	3.78	1.15	30.76	40.50	7.58	16.23
4664	Honduras rice straw, D. E. XVIII, Sample 2.	4.17	1.15	30.53	40.73	7.34	16.08
	Average	3.98	1.15	30.65	40.62	7.46	16.16
4668	Residue, D. E. XVIII	4.11	1.04	28.49	42.85	6.73	16.78
4669	Residue, D. E. XVIII	3.19	0.58	32.49	41.33	6.63	15.76

TABLE 7—COMPOSITION OF EXCREMENTS FROM DIGESTION EXPERIMENTS.

Laboratory No.	Sheep: Digestion—Experiment: Feed.	Protein.	Fat.	Crude fiber.	Nitrogen free-extract.	Water.	Ash.
3222	Sheep 2, D. E. I, Cowpea hay	9.56	4.97	29.88	27.65	9.15	18.79
3223	Sheep 3, D. E. I, Cowpea hay	9.51	5.14	29.62	28.28	8.50	18.95
3258	Sheep 1, D. E. II, Sorghum hay	10.06	2.07	24.37	43.98	7.33	12.19
3259	Sheep 2, D. E. II, Sorghum hay	10.06	2.00	25.21	43.40	7.45	11.88
3260	Sheep 3, D. E. II, Sorghum hay	10.08	2.04	24.20	43.66	7.87	12.15
3279	Sheep 2, D. E. III, Alfalfa hay	11.12	3.62	40.82	27.78	7.26	9.40
3280	Sheep 3, D. E. III, Alfalfa hay	11.56	3.58	40.57	28.50	6.30	9.49
3281	Sheep 4, D. E. III, Alfalfa hay	11.39	3.57	42.13	28.08	6.39	8.44
3589	Sheep 1, D. E. IV, Johnson Grass hay.	9.98	1.80	19.68	42.68	5.62	20.24
3590	Sheep 3, D. E. IV, Johnson Grass hay.	9.36	1.77	18.47	42.97	5.42	22.01
3591	Sheep 4, D. E. IV, Johnson Grass hay.	8.93	1.68	19.83	43.19	5.74	20.63
3597	Sheep 1, D. E. V, Oat hay	9.75	2.22	23.39	40.97	4.99	18.68
3598	Sheep 4, D. E. V, Oat hay	8.92	2.02	26.67	41.51	4.52	16.36
3623	Sheep 2, D. E. VI, Burr clover	16.08	8.14	26.97	27.73	4.51	16.57
3624	Sheep 3, D. E. VI, Burr clover	16.57	8.04	26.87	27.77	4.56	16.19
3877	Sheep 2, D. E. VII, Rice straw	5.73	2.25	23.30	36.50	4.78	27.44
3878	Sheep 3, D. E. VII, Rice straw	5.61	2.10	24.20	37.30	4.88	25.91
3879	Sheep 4, D. E. VII, Rice straw	5.60	2.35	22.91	37.53	4.81	26.80
3700	Sheep 1, D. E. VIII, Vetch hay	10.37	2.44	33.32	25.72	5.31	22.84
3885	Sheep 2, D. E. IX, Buffalo Grass hay	7.27	1.69	24.60	41.79	5.21	19.44
3886	Sheep 3, D. E. IX, Buffalo Grass hay	7.28	1.70	25.13	41.46	5.14	19.29
3887	Sheep 4, D. E. IX, Buffalo Grass hay	7.09	1.68	25.69	41.84	5.04	18.66
4240	Sheep 1, D. E. X, Johnson Grass hay	8.76	1.80	27.18	41.94	6.94	13.38
4241	Sheep 3, D. E. X, Johnson Grass hay	8.65	1.76	24.17	45.10	6.84	13.48
4242	Sheep 4, D. E. X, Johnson Grass hay	8.03	1.83	24.66	45.60	6.78	13.10
4249	Sheep 1, D. E. XI, Millet	7.57	1.81	23.30	47.77	5.83	13.72
4250	Sheep 3, D. E. XI, Millet	7.07	1.76	21.68	48.00	5.80	15.69
4251	Sheep 4, D. E. XI, Millet	6.60	1.54	25.10	46.33	5.35	15.08
4254	Sheep 1, D. E. XII, Bermuda hay	6.91	1.61	26.21	45.37	7.81	12.09
4255	Sheep 3, D. E. XII, Bermuda hay	6.29	1.74	27.75	45.43	8.26	10.53
4256	Sheep 4, D. E. XII, Bermuda hay	6.27	1.67	26.30	46.51	8.26	10.97
4261	Sheep 1, D. E. XIII, Peanut hay	8.50	2.43	34.27	29.31	8.61	16.88
4262	Sheep 3, D. E. XIII, Peanut hay	9.49	2.75	32.87	27.57	8.74	18.58
4263	Sheep 4, D. E. XIII, Peanut hay	8.88	2.74	33.24	28.20	8.27	18.67
4279	Sheep 1, D. E. XIV, Para Grass hay	5.49	.91	29.13	45.96	7.89	10.62
4280	Sheep 3, D. E. XIV, Para Grass hay	5.23	.92	30.17	47.07	7.36	9.25
4281	Sheep 4, D. E. XIV, Para Grass hay	5.52	.91	30.46	45.86	7.56	9.69
4548	Sheep 4, D. E. XV, Kaffir fodder	9.69	2.36	22.41	40.92	7.35	17.27
4549	Sheep 5, D. E. XV, Kaffir fodder	10.15	3.10	30.10	31.44	7.10	18.11
4550	Sheep 6, D. E. XV, Kaffir fodder	11.04	2.77	20.13	41.00	7.24	17.82
4554	Sheep 1, D. E. XVI, Guam grass	8.25	1.58	22.66	47.36	9.71	10.44
4555	Sheep 3, D. E. XVI, Guam grass	8.03	1.43	23.69	47.86	9.81	9.18
4556	Sheep 5, D. E. XVI, Guam grass	8.98	1.58	22.82	46.50	9.62	10.50
4559	Sheep 1, D. E. XVII, Corn shucks	8.13	0.92	26.00	49.85	8.62	6.48
4560	Sheep 4, D. E. XVII, Corn shucks	8.95	1.06	25.38	49.55	8.58	6.48
4561	Sheep 5, D. E. XVII, Corn shucks	10.91	1.27	19.69	50.51	9.36	8.26
4665	Sheep 1, D. E. XVIII, Rice straw	5.16	1.31	23.32	38.18	6.84	25.19
4666	Sheep 4, D. E. XVIII, Rice straw	5.06	1.11	23.83	39.18	6.82	24.00
4667	Sheep 5, D. E. XVIII, Rice Straw	5.94	1.76	21.77	38.65	6.86	25.02

TABLE 8—NUTRIENTS FED, EXCRETED AND DIGESTED, IN GRAMS PER PERIOD.

Remarks.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Ash.
Period 1; Feed, Cowpea hay—					
Sheep No. 1; Fed 4000 gm. No. 3220-1	586.4	120.8	1047.2	1374.8	362.0
Eaten	586.4	120.8	1047.2	1374.8	362.0
Excreted 1729 gm. No. 3222	165.3	85.9	516.6	478.1	324.9
Digested	421.1	34.9	530.6	896.7	37.1
Percentage digested	71.81	28.88	50.67	65.22	10.25
Sheep No. 2; Fed 4000 gm. No. 3220-1	586.4	120.8	1047.2	1374.8	362.0
Eaten	586.4	120.8	1047.2	1374.8	362.0
Excreted 1687 gm. No. 3223	160.2	86.7	499.7	477.1	319.7
Digested	426.2	34.1	547.5	897.7	42.3
Percentage digested	72.68	28.23	52.28	65.29	11.69
Period 2; Sorghum Hay—					
Sheep No. 1; Fed 4800 gm. No. 3224-5	267.8	79.7	1347.4	2267.5	331.7
Eaten	267.8	79.7	1347.4	2267.5	331.7
Excreted 1860 gm. No. 3258	187.1	38.5	453.3	818.0	226.7
Digested	80.7	41.2	894.1	1449.5	105.0
Percentage digested	30.13	51.69	66.36	64.01	31.66
Period 2; Feed, Sorghum Hay—					
Sheep No. 2; Fed 4000 gm. No. 3224-5	223.2	66.4	1122.8	1889.6	276.4
Eaten	223.2	66.4	1122.8	1889.6	276.4
Excreted 1560 gm. No. 3259	156.9	31.2	393.3	677.0	185.3
Digested	66.3	35.2	729.5	1212.6	91.1
Percentage digested	29.7	53.01	64.97	64.18	329.6
Sheep No. 3; Fed 4000 gm. No. 3224-5	223.2	66.4	1122.8	1889.6	276.4
Residue 5 gm. No. 3224-5	0.3	0.1	1.4	2.4	0.3
Eaten	222.9	66.3	1121.4	1887.2	276.1
Excreted 1440 gm. No. 3260	145.2	29.4	348.5	628.7	175.0
Digested	77.7	36.9	772.9	1258.5	101.1
Percentage digested	34.86	55.66	68.92	66.68	36.62
Period No. 3; Feed, Alfalfa Hay—					
Sheep No. 2; Fed 4400 gm. No. 3277-8	711.5	62.0	1247.0	1538.2	358.2
Residue 3 gm. No. 3277-8	0.5	-------	0.9	1.0	0.2
Eaten	711.0	62.0	1246.1	1537.2	358.0
Excreted 1667 gm. No. 3279	185.4	60.3	680.5	463.1	156.7
Digested	525.6	1.7	565.6	1074.1	201.3
Percentage digested	73.92	2.74	45.39	69.88	55.95
Sheep No. 3; Fed 4400 gm. No. 3277-8	711.5	62.0	1247.0	1538.2	357.2
Eaten	711.5	62.0	1247.0	1538.2	357.2
Excreted 1511 gm. No. 3280	174.7	54.1	613.0	655.8	143.4
Digested	536.8	7.9	634.0	882.4	213.8
Percentage digested	75.46	12.74	50.80	57.37	59.86
Sheep No. 4; Fed 4400 gm. No. 3277-8	711.5	62.0	1247.0	1538.2	357.2
Residue 86 gm. No. 3283	9.2	0.6	36.4	28.8	7.0
Eaten	702.3	61.4	1210.6	1509.4	350.2
Excreted 1732 gm. No. 3281	197.3	61.8	729.7	486.3	146.2
Digested	505.0	0.4	480.9	1023.1	204.0
Percentage digested	71.91	0.65	39.72	67.78	58.27
Period 4; Johnson Grass Hay—					
Sheep 1; Fed 3600 gm. No. 3587-8	26.78	60.5	986.4	1527.8	445.0
Residue 110 gm. No. 3592	5.8	1.0	14.4	21.5	60.4
Eaten	262.0	59.5	972.0	1506.3	384.4
Excreted 1720 gm. No. 3589	171.7	31.0	338.5	734.5	348.1
Digested	90.3	28.5	633.5	772.2	36.3
Percentage digested	34.47	47.90	65.17	51.27	9.44

TABLE 8—NUTRIENTS FED, EXCRETED AND DIGESTED, IN GRAMS PER PERIOD—continued.

Remarks.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Ash.
Sheep No. 3; Fed 3600 gm. No. 3587-8	267.8	60.5	986.4	1527.8	445.0
Residue 471 gm. No. 3593	18.7	2.7	163.2	171.9	52.7
Eaten	249.1	57.8	823.2	1355.9	392.3
Excreted 1476 gm. No. 3590	138.2	26.1	272.6	634.2	324.9
Digested	110.9	31.7	550.6	721.7	67.4
Percentage digested	44.52	54.83	66.88	53.23	17.18
Sheep No. 4; Fed 3600 gm. No. 3587-8	267.8	60.5	986.4	1527.8	445.0
Residue 158 gm. No. 3594	7.2	0.9	42.4	45.4	47.8
Eaten	260.6	59.6	944.0	1482.4	397.2
Excreted 1637 gm. No. 3591	146.2	27.5	324.6	707.0	337.7
Digested	114.4	32.1	619.4	775.4	59.5
Percentage digested	43.90	53.86	65.61	52.31	14.98
Period 5; Feed, Oat Hay—					
Sheep No. 1; Fed 4000 gm. No. 3595-6	321.6	96.4	1114.8	1768.8	360.8
Residue 173 gm. No. 3599	14.2	3.7	42.4	166.9	32.7
Eaten	307.4	92.7	1072.4	1701.9	338.1
Excreted 1281 gm. No. 3597	124.9	28.4	299.6	524.8	239.3
Digested	182.5	64.3	772.8	1177.1	98.8
Percentage digested	59.37	69.36	72.06	69.16	29.22
Sheep No. 4; Fed 4000 gm. No. 3595-6	321.6	96.4	1114.8	1768.8	360.8
Residue 242 gm. No. 3600	19.3	4.8	65.3	96.2	37.3
Eaten	302.3	91.6	1049.5	1672.6	323.5
Excreted 1433 gm. No. 3598	127.8	28.9	382.2	594.8	234.4
Digested	174.5	62.1	667.3	1077.8	89.1
Percentage digested	57.72	68.45	63.58	64.44	27.54
Period 6; Burr Clover Hay—					
Sheep No. 2; Fed 4000 gm. No. 3609-10	937.2	84.8	832.4	1273.2	484.0
Residue 5 gm. No. 3609-10	1.2	0.1	1.0	1.6	0.6
Eaten	936.0	84.7	831.4	1271.6	483.4
Excreted 1096 gm. No. 3623	176.2	89.2	295.6	303.9	181.6
Digested	759.8	4.5	535.8	967.7	301.8
Percentage digested	81.18	5.31	64.44	76.10	62.43
Sheep No. 3; Fed 4000 gm. No. 3609-10	937.2	84.8	832.4	1273.2	484.0
Residue 15 gm. No. 3609-10	3.6	0.3	2.0	4.8	1.8
Eaten	933.6	84.5	829.4	1268.4	482.2
Excreted 1110 gm. No. 3624	183.9	89.2	298.3	308.2	179.7
Digested	749.7	4.7	531.1	960.2	302.5
Percentage digested	80.30	5.56	64.03	75.70	62.73
Period 7; Feed Rice Straw—					
Sheep No. 2; Fed 3600 gm. No. 3625-6	141.1	44.6	1197.4	1361.5	615.6
Residue 53 gm. No. 3880	2.9	0.6	17.5	19.1	9.4
Eaten	138.2	44.0	1179.9	1342.4	606.2
Excreted 1914 gm. No. 3877	119.7	43.1	446.0	698.6	525.2
Digested	18.5	0.9	733.9	643.8	81.0
Percentage digested	13.39	20.46	62.20	47.96	13.36
Sheep No. 3; Fed 3600 gm. No. 3625-6	141.1	44.6	1197.4	1361.5	615.6
Residue 305 gm. No. 3881	11.2	2.4	109.1	110.6	57.2
Eaten	129.9	42.2	1088.3	1250.9	558.4
Excreted 1933 gm. No. 3878	108.5	40.6	467.8	721.0	500.8
Digested	21.4	1.6	620.5	529.9	57.6
Percentage digested	16.47	3.79	57.02	42.36	10.31
Sheep No. 4; Fed 3600 gm. No. 3625-6	141.1	44.6	1197.4	1361.5	615.6
Residue 170 gm. No. 3882	6.6	1.9	56.8	65.5	28.9

TABLE 8—NUTRIENTS FED, EXCRETED AND DIGESTED, IN GRAMS PER PERIOD—continued.

Remarks.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Ash.
Eaten	134.5	42.7	1140.6	1296.0	586.7
Excreted 1912 gm. No. 3879	107.1	44.9	438.0	717.6	512.4
Digested	27.4	2.2	702.6	578.4	74.3
Percentage digested	20.37	5.17	61.60	44.63	12.66
Period 8; Feed Vetch Hay—					
Sheep No. 1; Fed 4000 gm. No. 3649-50	600.0	63.2	1091.2	1501.2	474.8
Eaten	600.0	63.2	1091.2	1501.2	474.8
Excreted 1491 gm. No. 3700	154.6	36.4	496.8	383.5	340.5
Digested	445.4	26.8	594.4	1117.7	134.3
Percentage digested	74.23	42.41	54.47	74.45	28.29
Period 9; Buffalo Grass Hay—					
Sheep No. 3; Fed 4000 gm. No. 3883-4	282.0	48.0	1105.6	1817.2	462.0
Residue 5 gm. No. 3883-4	0.4	0.1	1.4	2.3	0.6
Eaten	281.6	47.9	1104.2	1814.9	461.4
Excreted 1881 gm. No. 3886	136.9	32.0	472.7	779.9	362.7
Digested	144.7	15.9	631.5	1035.0	98.7
Percentage digested	51.38	33.19	57.20	57.03	21.40
Sheep No. 2; Fed 4000 gm. No. 3883-4	282.0	48.0	1105.6	1817.2	462.0
Eaten	282.0	480.0	1105.6	1817.2	462.0
Excreted 1701 gm. No. 3885	123.7	28.8	418.4	710.8	330.7
Digested	158.3	19.2	687.2	1106.4	131.3
Percentage digested	56.13	40.00	62.16	60.88	28.42
Period 10; Feed Johnson Grass Hay—					
Sheep No. 1; Fed 4000 gm. No. 4238-9	276.8	56.0	1230.4	1789.2	325.2
Residue 10 gm. No. 4238-9	0.3	0.1	1.5	2.2	0.4
Eaten	276.5	55.9	1228.9	1787.0	324.8
Excreted 1512 gm. No. 4240	132.5	27.2	410.9	634.1	202.3
Digested	144.0	28.7	818.0	1152.9	122.5
Percentage digested	52.08	51.35	66.56	64.52	37.71
Sheep No. 3; Fed 4000 gm. No. 4238-9	276.8	56.0	1230.4	1789.2	325.2
Residue 5 gm. No. 4238-9	0.3	0.1	1.5	2.2	0.4
Eaten	276.5	55.9	1228.9	1787.0	324.8
Excreted 1577 gm. No. 4241	136.4	27.8	381.2	711.2	212.6
Digested	140.1	28.1	847.7	1075.8	112.2
Percentage digested	50.67	50.27	68.98	60.20	34.54
Sheep No. 4; Fed 4000 gm. No. 4238-9	276.8	56.0	1230.4	1789.2	325.2
Residue 5 gm. No. 4238-9	0.7	0.1	3.8	4.5	0.8
Eaten	276.1	55.9	1226.6	1784.7	324.4
Excreted 1634 gm. No. 4242	131.2	29.9	402.9	745.1	214.0
Digested	144.9	26.0	823.7	1039.6	110.4
Percentage digested	52.48	46.51	67.15	58.25	34.03
Period 11; Feed Baled Millet—					
Sheep No. 1; Fed 4000 gm. No. 4247-8	168.8	64.8	1116.4	1934.8	358.8
Residue 34 gm. No. 4247-8	1.4	0.6	9.5	16.4	3.0
Eaten	167.4	64.2	1106.9	1918.4	355.8
Excreted 1686 gm. No. 4249	127.6	30.5	392.8	805.4	231.3
Digested	39.8	33.7	714.1	1113.0	124.5
Percentage digested	23.77	52.49	64.51	57.96	34.99
Sheep No. 3; Fed 4000 gm. No. 4247-8	168.8	64.8	1116.4	1934.8	358.8
Residue 20 gm. No. 4247-8	0.8	0.3	5.6	9.7	1.8
Eaten	168.0	64.5	1110.8	1925.1	357.0
Excreted 1564 gm. No. 4250	110.6	27.5	339.1	750.7	245.4
Digested	57.4	37.0	771.7	1174.4	111.6
Percentage digested	34.17	57.36	69.47	61.01	31.26

TABLE 8—NUTRIENTS FED, EXCRETED AND DIGESTED, IN GRAMS PER PERIOD—continued.

Remarks.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Ash.
Sheep No. 4; Fed 4000 gm. No. 4247-8	168.8	64.8	1116.4	1934.8	358.8
Residue 30 gm. No. 4247-8	1.3	0.5	8.4	14.5	2.7
Eaten	167.5	64.3	1108.0	1920.3	356.1
Excreted 1704 gm. No. 4251	112.5	26.2	427.7	789.5	257.2
Digested	55.0	38.1	680.3	1130.8	98.9
Percentage digested	32.84	59.29	61.39	58.88	27.77
Period 12; Feed Bermuda Hay—					
Sheep No. 1; Fed 4000 gm. No. 4252-3	257.2	64.0	1104.8	1868.0	315.2
Residue 12 gm. No. 4252-4	0.8	0.2	3.3	5.6	0.9
Eaten	256.4	63.8	1101.5	1862.4	314.3
Excreted 1920 gm. No. 4254	132.7	30.9	503.2	871.1	232.1
Digested	123.7	32.9	598.3	991.3	82.2
Percentage digested	48.25	51.57	54.32	53.23	26.15
Sheep No. 3; Fed 4000 gm. No. 4252-3	257.2	64.0	1104.8	1868 0	315.2
Residue 12 gm. No. 4252-4	0.8	0.2	3.3	5.6	0.9
Eaten	256.4	63.8	1101.5	1862.4	314.3
Excreted 2110 gm. No. 4255	132.7	36.7	585.5	958.6	222.2
Digested	123.7	27.1	516.0	903.8	92.1
Percentage digested	48.25	42.48	46.84	48.53	29.30
Sheep No. 3; Fed 4000 gm. No. 4252-3	257.2	64.0	1104.8	1868.0	315.2
Residue 15 gm. No.	1.0	0.2	4.0	7.0	1.2
Eaten	256.2	63.8	1100.8	1861.0	314.0
Excreted 2044 gm. No. 4256	128.2	34.1	537.6	951.7	224.2
Digested	128.0	29.7	563.2	909.3	89.8
Percentage digested	49.96	46.55	48.86	51.16	28.60
Period 13; Feed Peanut Hay—					
Sheep No. 1; Fed 4000 gm. No. 4259-60	542.4	352.4	912.8	1560.8	297.6
Eaten	542.4	342.4	912.8	1560.8	297.6
Excreted 1335 gm. No. 4261	113.6	32.4	457.5	391.3	225.3
Digested	428.8	310.0	455.3	1169.5	72.3
Percentage digested	79.06	90.53	49.88	74.93	24.29
Sheep No. 3; Fed 4000 gm. No. 4250-60	542.4	342.4	912.8	1560.8	297.6
Eaten	542.4	342.4	912.8	1560.8	297.6
Excreted 1246 gm. No. 4262	118.2	34.3	409.6	343.5	231.5
Digested	424.2	308.1	503.2	1117.3	66.1
Percentage digested	78.21	90.00	55.13	71.58	22.21
Sheep No. 4; Fed 4000 gm. No. 4259-60	542.4	342.4	912.8	1560.8	297.6
Eaten	542.4	342.4	912.8	1560.8	297.6
Excreted 1315 gm. No. 4263	116.8	36.0	437.1	370.8	245.5
Digested	425.6	306.4	475.7	1190.0	52.1
Percentage digested	78.47	89.49	52.11	76.24	17.51
Period 14; Feed Para Grass—					
Sheep No. 1; Fed 4000 gm. No. 4277-8	133.6	36.4	1352.9	1869.6	284.0
Residue 212 gm. No. 4282	8.1	2.1	67.4	97.9	17.5
Eaten	125.5	34.3	1284.6	1771.7	266.3
Excreted 2043 gm. No. 4279	112.2	18.6	595.1	939.0	217.0
Digested	13.3	15.7	689.5	832.7	49.5
Percentage digested	10.60	45.77	53.67	47.00	18.57
Sheep No. 3; Fed 4000 gm. No. 4277-8	133.6	36.4	1352.0	1869.6	284.0
Residue 40 gm. No. 4283	1.5	0.4	11.9	18.7	4.1
Eaten	132.1	36.0	1340.1	1850.9	279.9
Excreted 2175 gm. No. 4280	113.8	20.0	656.2	1023.8	201.2

TABLE 8—NUTRIENTS FED, EXCRETED AND DIGESTED, IN GRAMS PER PERIOD—continued.

Remarks.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Ash.
Digested	18.3	16.0	683.9	827.1	78.7
Percentage digested	13.86	44.44	51.03	44.69	28.12
Sheep No. 4; Fed 4000 gm. No. 4277-8	133.6	36.4	1352.0	1869.6	284.0
Residue 648 gm. No. 4284	31.6	7.5	198.7	290.9	64.0
Eaten	102.0	28.9	1153.3	1578.7	220.0
Excreted 1751 gm. No. 4281	96.7	15.9	533.4	803.0	169.7
Digested	5.3	13.0	619.9	775.7	50.3
Percentage digested	5.20	45.00	53.75	49.13	22.87
Period 15; Feed Kafir Fodder (Baled)—					
Sheep No. 5; Fed 4000 gm. No. 4546-7	399.6	85.2	952.0	1773.2	450.0
Eaten	399.6	85.2	952.0	1773.2	450.0
Excreted 1409 gm. No. 4548	136.5	33.3	315.8	576.6	243.3
Digested	263.1	51.9	636.2	1196.6	206.7
Percentage digested	65.84	60.92	66.83	67.48	45.93
Sheep No. 5; Fed 4000 gm. No. 4546-7	399.6	85.2	952.0	1173.2	450.0
Eaten	399.6	85.2	952.0	1773.2	450.0
Excreted 1433 gm. No. 4549	145.4	44.4	431.3	450.5	259.5
Digested	254.2	40.8	520.7	1322.7	190.5
Percentage digested	63.63	47.89	54.70	74.59	42.33
Sheep No. 6; Fed 4000 gm. No. 4546-7	399.6	85.2	952.0	1773.2	450.0
*Residue 308 gm. No. 4551	26.6	5.5	91.8	121.9	35.3
Eaten	426 2	87.7	1043.8	1895.1	485.2
Excreted 1567 gm. No. 4550	173.0	43.4	315.4	642.5	279.2
Digested	253.2	44.3	728.4	1252.6	206.1
Percentage digested	59.41	50.51	69.78	66.09	42.47
Period 16; Feed Guam Grass—					
Sheep No. 1; Fed 4000 gm. No. 4552-3	337.2	69.2	1040.0	1976.0	271.6
Eaten	337.2	69.2	1040.0	1976.0	271.6
Excreted 1899 gm. No. 4554	156.7	30.0	430.3	899.4	198.3
Digested	170.5	39.2	609.7	1076.6	73.3
Percentage digested	50.56	56.65	58.63	54.48	26.99
Sheep No. 3; Fed 4000 gm. No. 4552-3	337.2	69.2	1040.0	1976.0	271.6
Eaten	337.2	69.2	1040.0	1976.0	271.6
Excreted 1888 gm. No. 4555	151.6	27.0	447.3	903.6	173.3
Digested	185.6	42.2	592.7	1072.4	98.3
Percentage digested	55.04	60.98	56.99	54.27	36.19
Sheep No. 5; Fed 4000 gm. No. 4552-3	337.2	69.2	1040.0	1976.0	271.6
Eaten	337.2	69.2	1040.0	1976.0	271.6
Excreted 2015 gm. No. 4556	180.9	31.8	459.8	937.0	211.6
Digested	156.3	37.4	580.2	1039.0	60.0
Percentage digested	46.35	54.05	55.77	52.59	22.09
Period 17; Feed Corn Shucks—					
Sheep No. 1; Fed 3200 gm. No. 4557-8	102.4	21.8	970.2	1747.2	111.0
Added 45 gm No. 4557-8	1.4	0.3	13.6	24.6	1.6
Eaten	103.8	22.1	983.8	1771.8	112.6
Excreted 1350 gm. No. 4559	109.8	12.4	351.0	673.0	87.5
Digested	6.0	9.7	632.8	1098.8	25.1
Percentage digested	5.78	43.89	64.32	62.03	22.29

*Residue from preliminary period eaten.

TABLE 8—NUTRIENTS FED, EXCRETED AND DIGESTED, IN GRAMS PER PERIOD—continued.

Remarks.	Protein.	Ether extract.	Crude fiber.	Nitrogen free-extract.	Ash.
Sheep No. 4; Fed 3200 gm. No. 4557-8	102.4	21.8	970.2	1747.2	111.0
Added 12 gm. No. 4557-8	1.1	0.1	2.8	4.9	2.2
Eaten	103.5	21.9	973.0	1752.1	113.2
Excreted 1268 gm. No. 4560	113.5	13.4	321.8	928.3	82.2
Digested	10.0	8.5	651.2	923.8	31.0
Percentage digested	9.66	38.82	66.93	52.73	27.37
Sheep No. 5; Fed 3200 gm. No. 4557-8	102.4	21.8	970.2	1747.2	111.0
Added ——gm. No. 4557-8	0.1	0.0	1.2	2.2	0.1
Eaten	102.5	21.8	971.4	1749.4	111.1
Excreted 1147 gm. No. 4561	125.1	14.6	225.8	579.3	94.7
Digested	22.6	7.2	745.6	170.1	16.4
Percentage digested	22.05	33.03	76.75	66.89	14.76
Period 18; Feed Honduras Rice Straw (Baled)—					
Sheep No. 1; Fed 3200 gm. No. 4663-4	127.4	36.8	980.8	1299.8	517.1
Residue 3 gm. No. 4663-4	0.1	0.0	0.9	1.2	0.5
Eaten	127.3	36.8	979.9	1298.6	506.6
Excreted 1691 gm. No. 4665	87.3	22.2	39.43	645.0	426.0
Digested	40.0	14.6	585.6	653.6	80.6
Percentage digested	31.42	39.67	59.76	50.33	15.91
Sheep No. 4; Fed 3200 gm. No. 4663-4	127.4	36.8	980.8	1299.8	517.1
Added 45 gm. No. 4668	1.8	0.5	12.8	19.3	7.6
Eaten	129.2	37.3	936.6	1319.1	524.7
Excreted 1708 gm. No. 4666	86.6	19.0	408.0	670.8	410.9
Digested	42.6	18.3	585.6	648.3	113.8
Percentage digested	32.97	49.05	58.94	49.14	21.69
Sheep No. 5; Fed 3200 gm. No. 4663-4	127.4	36.8	980.8	1299.8	517.1
Residue 777 gm. No. 4669	24.8	4.5	252.4	321.1	122.5
Eaten	102.6	32.3	728.4	978.7	394.6
Excreted 1450 gm. No. 4667	86.7	25.7	317.6	563.9	365.0
Digested	15.9	6.6	410.8	414.8	29.6
Percentage digested	15.50	20.43	56.39	42.38	7.50

TABLE 9—COMPOSITION OF HAYS AND FODDERS REPORTED BY VARIOUS EXPERIMENT STATIONS.

Description.	Protein.	Fat.	Crude fiber.	Nitrogen free-extract.	Water.	Ash.	Reference No.
Alfalfa hay	13.35	1.74	29.24	32.32	17.03	6.22	33
Alfalfa hay	13.12	0.80	41.05	30.17	5.23	9.63	2
Alfalfa hay	15.03	1.62	30.28	35.55	7.75	11.77	2
Alfalfa hay, first cutting	14.61	1.75	29.07	36.97	8.54	9.06	26
Alfalfa hay, second cutting	13.88	1.66	32.57	35.96	6.88	9.05	26
Alfalfa hay, second cutting	15.08	1.62	30.80	37.36	6.44	8.70	25
Alfalfa hay, first cutting	16.45	1.94	29.78	35.13	7.23	9.47	25
Alfalfa hay, second cutting	15.77	1.54	30.01	37.51	6.11	9.09	27
Alfalfa hay	19.66	2.59	25.19	40.52	4.10	7.94	24
Alfalfa hay, first cutting, 10 per cent in bloom.	16.88	1.42	29.38	34.01	8.77	9.54	31
Alfalfa hay, first cutting, 50 per cent in bloom.	15.88	1.25	31.41	34.23	7.71	9.49	31
Alfalfa hay, first cutting, full bloom	13.23	1.30	33.11	36.34	8.29	7.75	31
Alfalfa hay, first cutting in bloom	13.81	2.26	27.28	34.97	15.02	6.69	39
Alfalfa hay, first cutting	11.54	2.39	26.11	36.90	14.61	8.45	39
Alfalfa hay, first cutting	11.64	2.35	19.92	48.47	9.75	7.87	39
Alfalfa hay, first cutting, average of 22 samples.	14.86	1.80	32.31	33.57	6.99	10.47	1
Alfalfa hay, second cutting, average of 14 samples.	15.18	1.68	30.90	34.79	7.24	10.21	1
Alfalfa hay, third cutting, average of 11 samples.	13.81	1.58	32.98	34.90	6.80	9.95	1
Alfalfa hay	12.48	2.72	30.92	34.74	10.00	9.15	
Alfalfa hay	15.25	2.18	29.42	33.77	12.42	6.96	4
Alfalfa hay	13.81	2.26	27.28	34.97	15.02	6.69	5
Alfalfa hay	12.25	3.51	31.05	34.09	10.94	8.16	19
Alfalfa hay	12.50	2.70	27.55	38.58	13.00	6.67	22
Alfalfa hay	8.68	1.30	42.61	33.15	7.71	6.55	23
Alfalfa hay, average of 5 samples	13.60	1.51	27.16	42.23	8.60	7.50	
Alfalfa hay, in bloom	16.87	2.01	27.12	36.11	10.00	7.89	35
Alfalfa hay in dough	14.12	2.07	28.72	35.07	12.48	7.54	34
Alfalfa hay	12.91	3.04	28.91	32.26	15.35	7.53	37
Alfalfa hay, average fourth cutting	15.15	1.90	28.20	40.10	5.00	9.30	38
Alfalfa hay, average fourth cutting	20.50	1.88	26.69	28.49	12.75	11.18	21
Alfalfa hay	16.50		29.62		7.92	6.58	21
Alfalfa hay			26.50		11.62	7.49	21
Alfalfa hay	10.37	1.62	31.06	40.03	8.92	8.05	21
Alfalfa hay, this bulletin	16.17	1.41	28.34	34.96	10.99	8.14	40
Alfalfa hay, average (34)	14.42	1.97	29.98	35.81	9.61	8.41	
Bermuda hay	8.75	2.19	21.65		10.00	8.60	9
Bermuda hay, 18 anal., first year after planting.	18.72	2.49	21.57	40.71	7.38	9.13	32
Bermuda hay, 16 anal., second year after planting.	11.91	2.09	24.85	46.60	6.52	8.03	32
Bermuda hay, 13 anal., third year after planting.	11.95	1.89	24.15	44.84	10.74	6.43	32
Bermuda hay	11.50	1.34	19.96	45.09	14.30	7.81	39
Bermuda hay	9.16	1.83	20.16	46.06	14.30	8.49	39
Bermuda hay	8.75	2.19	21.64	48.46	10.36	8.60	39
Bermuda hay	10.75	2.90	25.02	50.71	7.14	3.46	39
Bermuda hay, this bulletin	6.43	1.60	27.62	46.70	9.74	7.88	40
Bermuda hay, average (8)	10.88	2.14	22.96	46.39	10.05	7.60	
Burr or California clover	12.65	4.15	31.76	30.97	11.15	9.32	19
Burr or California clover, this bulletin	23.43	2.12	20.81	31.83	9.73	12.10	40
Burr or California clover, average (2)	18.04	3.13	26.28	31.40	10.44	10.71	
Buffalo grass hay	11.13	2.00	24.10	42.33	8.16	12.10	31
Buffalo grass hay	5.19	2.28	26.66	48.25	7.24	10.38	23
Buffalo grass hay, this bulletin	7.05	1.20	27.64	45.43	7.30	11.55	40
Buffalo grass hay, average (3)	7.85	1.82	26.13	45.29	7.57	11.34	
Corn shucks, average (3)	2.35	0.52	29.85	55.68	9.00	2.60	8
Corn shucks, this bulletin	3.20	0.68	30.32	54.60	7.75	3.47	40
Corn shucks, average (2)	2.77	0.60	30.08	55.14	8.37	3.03	
Cow pea vine, overripe, leaves fallen	12.64	1.33	29.58	40.44	11.26	4.76	39
Cow pea vine, full bloom	20.20	3.20	29.42	30.03	5.87	11.27	1
Cow pea vine in full pod	16.58	1.84	30.01	38.40	6.02	7.14	1
Cowpea	12.56	1.75	23.68	39.91	14.54	7.56	4
Cowpea, cut in full bloom	16.06	3.63	16.54	46.98	10.11	6.68	7

TABLE 9—COMPOSITION OF HAYS AND FODDERS REPORTED BY VARIOUS EXPERIMENT STATIONS—continued.

Description.	Protein.	Fat.	Crude fiber.	Nitrogen free-extract.	Water.	Ash.	Reference No.
Cowpea, pods two-thirds grown	17.67	2.71	16.42	44.86	11.33	7.01	7
Cowpea, average of 3 anal.	17.61	3.61	19.64	40.32	10.29	8.13	8
Cowpea hay	16.09	3.64	23.14	41.76	8.90	6.47	11
Cowpea, pods turning yellow	8.37	1.75	30.16	42.82	10.00	6.80	15
Cowpea, overripe	9.57	2.88	29.34	39.45	10.00	8.76	20
Cowpea vine, green	15.30	2.60	22.21	41.40	10.00	8.49	20
Cowpea vine	15.95	3.63	16.63	47.01	10.11	6.67	17
Cowpea vine, average (6) anal.	13.82	2.37	20.54	44.28	10.00	8.90	17
Cowpea vine, average (3) anal.	15.42	3.67	19.60	43.34	9.57	8.40	29
Cowpea vine	14.10	2.51	16.73	49.52	11.00	6.14	35
Cow pea (early and late)	10.87	2.10	27.28	40.07	9.02	10.66	21
Cowpea, this bulletin	14.66	3.02	26.18	34.37	12.73	9.05	40
Cowpea vine, average (17)	14.56	2.72	23.31	41.53	10.04	7.82	
Johnson grass	7.20	1.55	30.99	44.47	10.00	5.79	39
Johnson grass, cut when panicles were forming for bloom.	5.77	1.67	30.30	44.80	12.31	5.15	39
Johnson grass	7.44	2.28	31.09	40.49	10.50	5.20	4
Johnson grass	8.70	2.38	29.82	44.32	7.57	7.21	16
Johnson grass, overripe	4.18	1.36	35.72	44.34	9.80	4.60	16
Johnson grass	12.77	2.71	29.17	39.78	9.86	5.71	23
Johnson grass	4.50	1.63	27.90	47.36	9.58	9.03	21
Johnson grass, this bulletin	7.44	1.68	27.40	42.44	8.69	12.36	40
Johnson grass, this bulletin	6.92	1.40	30.76	44.73	8.06	8.13	40
Johnson grass	10.11	2.43	21.47	44.77	14.30	6.92	41
Johnson grass	4.35	1.78	35.45	47.11	6.10	5.21	41
Johnson grass, average (11)	7.22	1.90	30.00	44.06	9.70	7.12	
Kafir fodder	3.31	2.50	30.37	47.40	10.94	5.48	4
Kafir fodder, milk stage	15.87	4.76	19.65	39.48	8.41	11.90	21
Kafir, fodder, flour stage	14.25	5.03	18.93	40.79	7.13	13.87	21
Kafir fodder, heading	17.50	4.19	22.59	39.80	7.07	8.85	21
Kafir fodder, dough	14.75	4.88	21.58	34.40	7.23	17.16	21
Kafir fodder, dough	16.12	5.55	19.66	35.07	9.26	14.34	21
Kafir fodder, this bulletin	9.90	2.13	23.80	44.33	8.57	11.25	40
Kafir fodder, average (7)	13.10	4.15	22.37	40.18	8.37	11.83	
Millet, barnyard, late bloom	9.37	1.36	30.12	37.59	12.77	5.89	39
Millet, cattail, panicles just forming	11.56	2.28	26.82	40.20	11.04	8.10	39
Millett, average composition	7.59	1.78	27.53	49.19	7.25	6.18	3
Millet, German	6.75	1.83	26.60	47.61	10.82	6.39	4
Millet, pearl	8.31	1.66	34.74	33.04	9.90	12.35	4
Millet, pearl headed	7.15	1.60	35.42	38.01	9.27	8.55	4
Millet, Hungarian	12.62	2.71	22.38	45.60	9.92	8.77	4
Millet, German, cut after full bloom	7.81	2.37	25.82	47.81	9.54	6.65	6
Millet, Ragi (India)	2.40	3.00	20.65	51.84	16.09	6.02	12
Millet, Kodo (India)	1.92	2.10	30.57	46.71	14.75	3.95	12
Millet, seeds in dough	5.71	2.34	28.01	45.78	10.00	8.18	15
Millet, German	7.87	2.45	30.85	43.53	6.70	8.60	18
Millet, golden	7.50	3.75	31.95	41.53	6.52	8.75	18
Millet, pearl	12.72	2.39	31.40	31.15	14.45	7.99	22
Millett	11.10	2.96	32.14	34.87	8.74	10.19	23
Millet, average 6 analyses	7.23	1.90	30.84	47.87	7.46	4.70	29
Millet hay	8.53	1.47	30.13	43.71	7.96	8.20	30
Millet	8.98	3.25	26.40	51.50	11.80	8.07	37
Millet, this bulletin	4.22	1.62	27.91	48.37	9.42	8.97	40
Millet, average 20 analyses	7.75	2.25	28.72	43.19	10.21	7.88	
*†Oat hay, cut in bloom	7.25	1.85	26.99	31.89	26.47	5.55	42
*†Oat hay, cut when grain was in milk	7.77	2.39	23.15	35.53	26.59	4.57	42
*†Oat hay, cut grain in dough	6.47	2.84	26.57	42.61	16.30	5.21	42
*†Oat hay, cut part bloom, part milk	8.80	2.79	28.87	39.37	13.76	6.41	42
*†Oat hay, cut part milk, part dough	6.59	3.30	29.45	41.13	13.28	6.25	42
Oat hay, fair grade, seed two-thirds grown.	9.80	4.10	25.80	42.50	12.30	5.50	41
Oat hay in bloom	6.16	2.73	31.87	46.81	6.43	6.00	29
Oat hay, in milk	9.85	2.43	31.04	41.63	9.55	5.50	29
Oat hay, ripe	5.52	2.38	33.15	44.67	8.70	5.58	29

*Calculated to original water content.
†Note high water content.

TABLE 9—COMPOSITION OF HAYS AND FODDERS REPORTED BY VARIOUS EXPERIMENT STATIONS—continued.

Description.	Protein.	Fat.	Crude fiber.	Nitrogen free-extract.	Water.	Ash.	Reference No.
Oat hay, nearly ripe	8.56	4.55	21.05	53.38	6.15	6.31	35
Oat hay, this bulletin	8.04	2.41	27.87	44.22	8.36	9.02	40
Oat hay, average (11)	7.72	2.89	27.80	42.16	13.44	5.99	
Peanut vine hay, some puffs and some nuts with meat.	10.32	8.57	25.96	42.92	10.44	6.80	4
Peanut vine hay	12.65	14.12	27.34	34.00	6.23	5.64	5
Peanut vine hay	11.43	5.67	22.32	41.57	10.00	9.01	11
Peanut vine hay, this bulletin	13.56	8.56	22.82	39.02	8.60	7.44	40
Peanut vine hay, average (4)	11.99	7.98	24.61	39.38	8.82	7.22	
Rice straw	4.36	1.99	30.89	44.58	5.88	12.30	8
Rice straw	3.00	1.27	33.98	42.11	6.76	12.88	10
Japan (Texas) this bulletin	3.92	1.24	33.26	37.82	6.68	17.10	40
Honduras (Texas) this bulletin	3.98	1.15	30.65	40.62	7.46	16.16	40
Honduras (Texas)	4.68	1.74	28.31	50.90	3.66	10.71	43
Honduras (Texas)	4.72	1.87	32.25	32.20	8.97	19.97	24
Average (6)	4.11	1.54	31.56	41.37	6.57	14.85	
Sorghum fodder	5.80	1.55	23.26	55.47	5.75	8.17	2
Sorghum fodder	7.81	2.05	33.15	44.84	7.15	5.00	24
Sorghum fodder, early orange	3.69	5.47	27.76	49.64	10.02	3.42	4
Sorghum fodder, early amber	5.20	4.27	30.68	45.19	10.49	4.17	4
Sorghum fodder, orange	13.75	3.77	20.01	46.23	7.81	8.43	21
Sorghum fodder, ripe	14.37	4.14	20.46	40.29	8.11	12.63	21
Sorghum fodder, sumac dough	11.62	4.25	19.67	47.88	7.13	9.45	21
Sorghum fodder, amber, ripe	13.50	4.18	18.23	36.06	10.78	17.25	21
Sorghum fodder, sourless, dough	8.87	4.22	23.05	42.11	8.87	12.88	21
Sorghum fodder	10.37	1.62	22.62	48.13	8.66	8.60	21
Sorghum fodder, this bulletin	5.58	1.66	28.07	47.24	10.56	6.91	40
Sorghum fodder, average (11)	9.10	3.42	24.40	45.73	8.55	8.80	
Vetch hay	12.20	1.54	24.56	36.49	18.64	6.57	36
Vetch hay, full bloom	25.81	3.71	15.78	35.74	9.85	9.11	9
Vetch hay, pods half developed	18.13	3.17	17.16	43.58	9.87	8.09	9
Vetch hay, hairy before bloom	23.45	2.22	20.24	26.25	20.72	7.12	13
Vetch hay, 5 per cent bloom	18.97	2.11	20.44	29.06	22.83	6.59	13
Vetch hay, full bloom	17.15	2.14	22.50	32.13	20.30	5.79	13
Vetch hay, seed pods formed but not filled.	18.71	2.35	19.92	29.50	22.48	7.04	13
Vetch hay	18.12	1.13	29.50	36.06	7.44	7.75	14
Vetch hay, common	13.75	2.28	27.67	39.90	8.90	7.51	14
Vetch hay, winter, in bloom	23.33	3.01	19.93	37.02	11.85	5.86	35
Vetch hay, spring, in bloom	15.99	2.41	26.13	37.30	11.08	7.09	35
Vetch hay	14.45	2.11	28.12	39.67	8.35	7.30	45
Vetch hay	13.06	2.43	27.31	40.15	9.45	7.70	45
Vetch hay, this bulletin	15.00	1.58	27.28	37.53	6.76	11.87	40
Vetch hay, average (14)	17.72	2.30	23.32	35.94	13.18	7.53	

TABLE 10—DIGESTIBILITY OF HAYS AND FODDERS REPORTED BY VARIOUS EXPERIMENT STATIONS.

Description.	Protein.	Fat.	Crude fiber.	Nitrogen free-extract.	Ash.	Reference No.
Alfalfa hay	68.81	15.75	41.31	69.05	24 41	32
Alfalfa hay	66.69	-------	47.76	56.69	45.65	2
Alfalfa hay	72.54	20.86	49.93	72.89	57.67	2
Alfalfa hay, first cutting	80.02	44.81	43.39	76.28	49.43	26
Alfalfa hay, second cutting	79.30	49.50	45.77	75.84	55.24	26
Alfalfa hay, second cutting	79.63	43.32	46.23	75.53	55.35	25
Alfalfa hay, first cutting	79.57	46.50	48.32	77.70	54.13	25
Alfalfa hay, second cutting	79.67	41.20	44.84	24.08	56.17	27
Alfalfa hay,	77.85	57.44	43.84	71.75	34.99	24
Alfalfa hay, first cutting, 10 per cent in bloom	78.52	60.00	46.10	75.31	63.49	31
Alfalfa hay, first cutting, 50 per cent in bloom	75.14	50.50	50.44	71.99	72.05	30
Alfalfa hay, full bloom	76.78	51.65	50.63	75.24	60.94	31
Alfalfa hay, in bloom	68.80	48.40	43.30	71.80	-------	39
Alfalfa hay	70.30	50.60	45.70	71.80	40.90	39
Alfalfa hay	77.00	54.00	49.00	64.00	38.00	39
Alfalfa hay, this bulletin	73.80	4.90	45.40	65.00	58.00	40
Alfalfa hay, average	75.27	40.57	46.37	68.43	50.08	-------
Bermuda hay	64.19	39.69	58.93	52.71	41.68	32
Bermuda hay, this bulletin	48.90	46.90	50.80	50.20	28.00	40
Bermuda hay, average	57.50	43.30	54.86	51.45	34.84	-------
Buffalo grass hay	54.39	62.41	64.65	61.71	60.40	31
Buffalo grass hay, this bulletin	53.20	35.50	58.40	58.00	24.30	40
Buffalo grass hay, average	53.79	48.95	61.53	59.85	15.17	-------
Cowpea vine, overripe, leaves fallen	64.80	51.80	42.00	70.60	49.50	33
Cowpea vine, this bulletin	72.30	28.60	51.50	65.30	11.00	40
Cowpea vine, average	68.50	40.70	46.70	67.90	30.30	-------
Johnson grass	38.10	37.20	73.50	59.40	4.80	39
Johnson grass, cut when panicles were formed for bloom.	44.70	29.50	57.80	54.40	56.10	39
Johnson grass, this bulletin	41.00	52.20	65.90	52.30	13.90	40
Johnson grass, this bulletin	51.80	49.30	67.60	61.00	33.40	40
Barnyard millet, late bloom	63.70	46.30	61.60	51.60	63.10	39
Cat tail millet, panicles just appearing	62.60	46.10	66.50	59.10	68.40	39
Millet, this bulletin	30.26	56.40	65.10	59.30	31.30	40
Millet, average	52.19	49.60	64.40	56.70	54.30	-------
Oat hay, cut in bloom	53.50	48.30	59.90	51.20	48.60	42
Oat hay, cut when grain was in milk	58.60	62.30	50.30	55.00	31.40	42
Oat hay, grain in dough	44.70	64.50	49.40	59.10	41.40	42
Oat hay, part bloom, part milk	63.60	63.60	54.50	57.50	37.70	42
Oat hay, part milk, part dough	47.60	71.60	52.50	59.70	38.20	42
Oat hay, early seed	54.20	61.90	43.50	52.00	-------	42
Oat hay, fair grade seeds, two-thirds grown	54.20	61.90	43.50	52.00	34.60	39
Oat hay, this bulletin	58.50	68.90	67.80	66.80	28.40	40
Oat hay, average	54.36	62.87	52.67	56.66	37.18	-------
Peanut vine hay, some pods and some nuts with meats.	63.30	65.90	51.50	69.50	20.40	39
Peanut vine hay, this bulletin	78.60	90.00	52.40	74.30	21.30	40
Peanut vine hay, average	70.95	77.95	52.15	71.90	20.85	-------
Sorghum fodder	43.06	64.87	49.23	61.06	44.61	2
Sorghum fodder	53.37	76.72	70.78	64.09	23.35	24
Sorghum fodder, this bulletin	31.56	53.45	66.75	64.96	33.75	40
Sorghum fodder, average	42.66	65.01	62.26	63.34	33.90	-------
Vetch hay	61.07	68.01	58.22	70.71	59.98	36
Vetch hay, this bulletin	74.20	42.40	54.50	74.50	28.30	40
Vetch hay, average	67.63	55.20	56.36	72.60	44.14	-------

TABLE 11—REFERENCES TO COMPOSITION AND DIGESTIBILITY OF FEEDS.

Reference Number.	Experiment station.	Publications.
1	Colorado	Bulletin 39
2	Colorado	Bulletin 93
3	New Jersey	Report 1888
4	North Carolina	Report 1889
5	New York (State)	Bulletin 16
6	Kentucky	Report 1888
7	South Carolina	Report 1888
8	South Carolina	Report 1888
9	South Carolina	Bulletin 3
10	South Carolina	Bulletin 59
11	Georgia	Bulletin 17
12	Alabama	Bulletin 60
13	Alabama	Bulletin 105
14	Alabama	Report 1893
15	Missouri	Report 1898
16	Mississippi	Report 1888
17	Louisiana	Bulletin 4
18	Louisiana	Bulletin 7
19	Louisiana	Bulletin 19
20	Louisiana	Bulletin 40
21	Texas	Bulletin 95
22	Texas	Report 1888
23	South Dakota	Bulletin 40
24	South Dakota	Bulletin 114
25	Wyoming	Bulletin 69
26	Wyoming	Bulletin 78
27	Wyoming	Report 1904-5
28	Massachusetts	Report 1889
29	Massachusetts	Report 1893
30	Kansas	Bulletin 32
31	Kansas	Bulletin 103
32	Oklahoma	Bulletin 90
33	Minnesota	Bulletin 99
34	Vermont	Bulletin 15
35	Vermont	Report 1887
36	Oregon	Bulletin 102
37	North Dakota	Bulletin 15
38	New Mexico	Bulletin 17
39	Office of Experiment Stations (U. S. Department of Agriculture)	Bulletin 77
40	Texas	This bulletin
41	Office of Experiment Stations (U. S. Department of Agriculture)	Bulletin 11
42	Maine	Report 1898
43	North Carolina	Report 1882
44	Louisiana	Bulletin 24
45	Massachusetts	Report 1884

SUMMARY AND CONCLUSIONS.

1. This Bulletin contains the results of 18 digestion experiments on Texas hays and fodders. It also contains a tabulation of similar experiments made elsewhere, and analyses of the same feeds.

2. The percentage of protein, fat, water and ash in burr clover decrease with the age of the plant, while the percentage of crude fiber increases.

3. The relative values of the feeds, coefficients of digestibility, digestible constituents, etc., are given in the tables.